THE PROGRESS OF TECHNICAL EDUCATION

INCLUDING

A QUARTER-CENTURY REVIEW

OF THE WORK OF THE

WORCESTER POLYTECHNIC INSTITUTE.

AN ADDRESS

BY

HOMER T. FULLER, PRESIDENT,

JUNE 21, 1894.

THE PROGRESS OF TECHNICAL EDUCATION

INCLUDING

A QUARTER-CENTURY REVIEW

OF THE WORK OF THE

WORCESTER POLYTECHNIC INSTITUTE.

AN ADDRESS

BY

HOMER T. FULLER, PRESIDENT,

JUNE 21, 1894.

WORCESTER, MASS.:
PRESS OF CHARLES HAMILTON,
311 MAIN STREET.
1894.

THE PROGRESS OF TECHNICAL EDUCATION.

A QUARTER-CENTURY REVIEW.

EVERY good thing in this world is a growth. Heroes appear full-panoplied only in fables. The crystalline gem is the product of years of slow accretion. So with all valuable human institutions. They are all growths which have slowly proceeded out of matter or mind, which have been wrought out by forces of intelligence, competent in time for almost any achievement, but which can really achieve only by persistent struggle and repeated experiment, and sometimes only on a basis of mere conjecture.

When an institution has passed through its formative period, has become well rooted and has made proof of its usefulness, it is worth while to begin its history. The quarter-century turn made by the Worcester Polytechnic Institute during the past year has presented the opportunity, which I have been requested to embrace, to plant a milestone that may be to others who may walk this way hereafter, both a mark of progress and a memento of its beginnings. But this cannot be most suitably done without a brief survey of the similar work that preceded the establishment of this Institute and that has been done elsewhere in the same time.

So far as I know, the earliest systematic industrial training in connection with any school was given at Moscow, Russia, beginning in 1763. This was at a charity school for foundling boys opened by the Empress Catharine II. Here workshops were opened and equipped to teach the boys trades —shoemaking, carpentry, tailoring, brass founding, etc.—that they might be able to earn an honest livelihood. This went on without much change for seventy years. In 1836 the foundling house became sorely crowded. A woman again, Maria Feodorovna, widow of Alexander I., like Mrs. Hemenway of our own State, came to the rescue, provided new quarters for three hundred boys, and finally, from her private fortune, endowed the school with the sum of $1,250,000. From 1836 to 1844 the studies of the school were increased, then it grew on the mechanical side, and in 1846 the Emperor Nicholas ordered the extension and re-equipment of the shops. In 1849 the course of training covered four years, two-thirds of the time being devoted to industrial work. This work was always upon articles for actual use, and in 1854–56 the school satisfactorily filled government orders for artillery equipments. This practical work on serviceable manufactures was the distinguishing feature of the original Russian system. It antedated the other so-called *Russian* system in vogue at St. Petersburg, and much lauded in this country by Prof. Runkle and others, by a hundred years. In 1860 the industrial school became the Imperial Technical School at Moscow, with a six years' course of study and an

average of fourteen hours a week given to shop practice.

In 1867 the Institute of Technology at St. Petersburg, with its five years' course of study, in which most of the practical work is done in the last year, was established. This is chiefly a school of chemistry and civil engineering, while at Moscow mechanical engineering is the leading course. This Institute also was preceded by a trade school.

Sweden began industrial work in schools about 1795; Bavaria, before 1806; and the polytechnic at Vienna dates from 1815.

L'Ecole Polytechnique of Paris, founded in 1790, was purely, as now, a school of military engineering.

Most of the other German technical high schools were organized from 1820 to 1870. Their work has, except in chemistry, been chiefly theoretical, till about 1880, when machine and wood shops were started at Berlin and Munich. Yet all of these, with one exception, have developed from lower or secondary industrial schools.

But France for more than forty years, or from 1825 to 1865, led the world in the practical applications of science in school instruction to the improvement of arts, trades, and manufactures. The central school at Paris and the Foremen's schools at Aix, Angers, and Chalon-sur-Marne, took up the higher work, followed by a multitude of trade and apprentice schools. Those of us who visited the exposition at Chicago will recall the fine specimens of wrought-iron work done at two of these French schools. But they were no better than this tea-table on the

platform at my left or the banquet lamps made at the Washburn Shops the past winter by members of the senior class of the Worcester Polytechnic Institute.

From France came the first engineers employed on our American canals and railroads. There our own early engineers were educated, and thence, in part from their work and in part from the necessities of our own projected enterprises, came the impulse which founded in 1824 the first civil engineering school of our land, the Rensselaer Polytechnic at Troy. This was a lone star for nearly twenty-five years.

In 1847, the period of establishing scientific departments of colleges began. Sheffield led the way in that year. Lawrence Scientific followed in 1848, the Chandler at Dartmouth in 1852, and the polytechnic department of Washington University in 1854. The first became chiefly a school of chemistry and mineralogy, the second a school of astronomy and pure mathematics—now under the guidance of its present dean having a strong inclination to geology, the third has always led toward civil engineering, while the fourth has been chiefly a mining school, but is now organized as an engineering department of the Washington University at St. Louis with seven courses of study.

But technical education in this country really began under the impulse of the national land grants in 1862. The causes of this action of the government were three-fold: (1) The known stimulus given both to agricultural interests and to foreign manufactures by the beginnings of technical educa-

tion in Europe. (2) The acknowledged superiority of those manufactures, especially in France and Switzerland, as shown by the exhibits of goods and wares at the earlier world's expositions. (3) The fact that in the first years of civil conflict, through the depredations of confederate cruisers, this country was compelled to rely on its own constructive energy and to develop its own resources. We learned at the cannon's mouth to make our own steel and engines and cruisers, our own mill machinery and machine tools, and to bind together by the strong bands of railway tracks the loose aggregations of States. Patriotic motives blended with the spirit of enterprise and the incentive of anticipated pecuniary advantage led to the large grants of land for the construction of railways and increased appropriations for the improvement of rivers and harbors. Ease of communication and facility of transportation would unify and centralize purpose and interest—would make the country one and indissoluble. More directly they would increase the price of land, attract immigration, make markets for products, and increase the country's wealth.

The "Morrill Act" of 1862, supplemented by the "Hatch Experiment Station" law of 1877, and the additional endowment act of 1890, has resulted in the organization or reorganization of sixty-five schools which receive aid from the government. About one-fourth of these are purely agricultural colleges, another fourth combine instruction in agriculture and mechanics, a third quarter have technical departments in connection with regular

college or university courses, and the remainder as yet are not fully organized, or give almost no training in the applications of science to the arts.

The whole number of these that affords thorough training for engineering pursuits is much fewer. Those most completely equipped are the Massachusetts Institute of Technology at Boston, Cornell University at Ithaca, N. Y., Purdue University at Lafayette, Ind., and the engineering departments of the Universities of Wisconsin, Missouri and California. Most of these were organized between 1865 and 1880. In addition there have been established seven independent technical schools on private foundations.* Of these the Worcester Polytechnic Institute (originally chartered as the Worcester County Free Institute of Industrial Science) was the third and the pioneer in this country of all those schools in which the actual construction of machinery is made a part of the course of instruction.

Nearly thirty years ago, in the later months of 1864, Mr. John Boynton of Templeton made known to Mr. David Whitcomb of this city, his former partner and most trusted friend, his purpose to devote the major part of the carefully treasured savings of a lifetime to the founding of a school for training for industrial pursuits. His first

* These are Rensselaer Polytechnic Institute, Troy, N. Y., organized 1824; Lehigh University, South Bethlehem, Pa., 1866; Worcester Polytechnic Institute, Worcester, Mass., 1868; Stevens Institute of Technology, Hoboken, N. J., 1871; Case School of Applied Science, Cleveland, O., 1881; Rose Polytechnic Institute, Terre Haute, Ind., 1883; State School of Technology, Atlanta, Ga., 1887.

thought had been to endow an academy at Templeton, then to endow and locate a school at Mason, N. H., his native place. But his friend, a man of rare sagacity, felt that the atmosphere of a country village would compare unfavorably with that of a thriving manufacturing city for such an enterprise, and, after some weeks' reflection, suggested that Worcester would be a better location. The result of the conference of the two men was that Mr. Boynton offered to locate in Worcester county, provided others would coöperate with him in furnishing buildings and equipment.

Mr. Whitcomb had, in January, 1865, consulted with his pastor, Rev. Seth Sweetser, concerning the best detailed plan for the use of these funds. Dr. Sweetser had already large experience in educational affairs, especially as trustee of Phillips Andover Academy and Seminary since 1850, and as an overseer of Harvard University, and, naturally, was the trusted adviser of men who had thought of bestowing money on educational projects. It then transpired that Mr. Ichabod Washburn had, at least a year previous, confided to Dr. Sweetser his thought of establishing a school for the training of apprentices. But as yet he had taken no definite steps towards carrying his plan into execution. Dr. Sweetser conceived the idea of uniting the two projects into one scheme, and after some deliberation Mr. Washburn very cordially acquiesced and nobly and generously co-operated.

Hon. Emory Washburn, President Hill of Harvard University, and Mr. Joseph White, Secretary of the

State Board of Education, were consulted, and very early Hon. Stephen Salisbury was privy to the plan. On the 6th of March, 1865, invitations were quietly sent out to thirty of the leading citizens of Worcester, asking them to meet at the office of Hon. George F. Hoar to consider the proposition of the unknown benefactor. At that meeting Messrs. Hoar, Sumner Pratt, Albert Curtis, Abram Firth, J. M. C. Armsby, and Stephen Salisbury, Jr., were appointed a committee to solicit subscriptions. The first public announcement of the matter was made in the *Worcester Palladium* of Wednesday, March 29, 1865, as follows: "A gentleman, who for the present withholds his name from the public, offers a fund of $100,000 for the establishment of a scientific school in Worcester, upon condition that the necessary land and buildings shall be furnished by our citizens."

Twelve thousand dollars were at once subscribed, and Mr. Ichabod Washburn later proposed to erect and equip a shop at a cost not to exceed $10,000. Fifty thousand dollars were deemed necessary for the erection of a suitable main building. For several reasons subscriptions came in slowly. First, it was deemed wise by those in charge of the project to test the interest of the citizens of Worcester in the enterprise. If it could not be made popular it would not succeed. Secondly, there were many distractions and uncertainties in those days. The financial and business outlook was, as it is to-day, an anxious gaze upon troubled waters. On March 1 of that year gold was sold at 202, 7-30 U. S.

bonds were below par, and cotton was eighty-five cents a pound. On March 30 gold fell to 148. In four days the fall of Richmond was announced, on April 9th Lee surrendered, and, six days later, President Lincoln was assassinated. The condition of the country absorbed attention and for a moment the outlook for all the future was as black as night. But the end of the civil strife was an encouragement. Stimulus was also given by the founding, about that time, of similar enterprises elsewhere. The Massachusetts Institute of Technology had begun its work in a private house in Boston in February of that year, and had in March applied for an amendment to its charter allowing it to hold property, the income of which should not exceed $30,000. The gift of $500,000 by Mr. Ezra Cornell to found a university was announced April 12.

The bill to incorporate the Institute was in final draft introduced into the legislature April 26. It was approved by Gov. John A. Andrew May 9. (Hon. A. H. Bullock was then speaker of the house and Hon. Jona. E. Field president of the senate.) On that day $30,000 had been subscribed. The Trustees have the original subscription paper. It includes the offer of a lot of land at the junction of Grove and Salisbury streets for a site, on the grounds now occupied by the State Armory. Mr. Boynton had at first stipulated that a building should be erected by the first of May, 1867, but the time was afterwards extended. He had confidence that the enterprise would succeed. "The aim of this school," he says, "shall ever be the instruction of youth in those

branches of education not usually taught in the public schools, which are essential and best adapted to train the young for practical life."

The corporation of the Institute was organized June 3. Hon. Stephen Salisbury, 2d, was chosen president; Phinehas Ball, then mayor, secretary, and David Whitcomb, treasurer. At the same meeting, with respect to the letter of gift and instructions from John Boynton, Esq., it was

"*Voted*, That the same be adopted and accepted as the terms upon which the donation of $100,000 is made, and that a substantial compliance therewith be considered the condition upon which said fund is to be held and managed."

This fund was already in the hands of the newly elected treasurer, but on the books of the Institute is entered as received May 1. Two facts concerning the original securities and later administration of the fund are worthy of notice:—

(1) That some of the original securities are still in the hands of the present treasurer unchanged.

(2) That the appreciation of securities and changes in investment, together with the natural income, made the growth of the fund in two years over $24,000.

This accumulation, by a later communication from Mr. Boynton, was set aside as a library and apparatus fund. On June 26 it was announced that $10,000 was still lacking, and the *Daily Spy*, with its usual public spirit, as it had done more than once before, published a strong appeal to the citizens to complete the subscriptions. The carriage-

makers responded in a body, and sent to the committee July 1 $241. Other workmen in twenty or more shops followed their example, and on August 5 the aggregate was announced as $50,694, from about five hundred givers. This was exclusive of the gift of Mr. Washburn for a machine shop. The sum was afterwards increased by further contributions, $10,000 from Mr. Salisbury, and accumulated interest, to $70,987, and on September 18, 1865, Mr. Salisbury offered the lot of land of five and one-half acres on which the Institute buildings now stand. This sum, and $4,000 besides, was applied to the erection of Boynton Hall, to its furnishing, and to the grading of the grounds. This grading, begun when the whole hill was covered with a dense wood, was done with rare taste and good judgment, under the direction of Mr. Vaux of New York, and to-day the Institute grounds, with its green slopes, its variety of shrubbery, blossoming afresh almost every week from early April till the summer vacation, is a delight to the eye and an important factor in the educative influence of the Institute.

On the second day of November, 1866, the building committee, consisting of Messrs. Whitcomb, Hoar, Lincoln, and Morgan, was appointed, and on the 11th day of November, 1868, Boynton Hall was dedicated and the real work of the Institute formally inaugurated. The Washburn Shops building was erected, but not at that time equipped. The records of that event are already in print, so that I will not repeat them. None of the gentle-

men who took part in the exercises of that occasion is now living, except Hon. George F. Hoar, who is the only survivor of the original trustees. Of the first instructors there are three, Messrs. George I. Alden, George E. Gladwin, and M. P. Higgins, present to-night, while Prof. J. E. Sinclair came but a few months later.

All these have rounded well the quarter-century which has elapsed since, and are in their prime of service. We might, were there time, pause here to speak of the brilliant and versatile, the honored and greatly lamented first principal, Dr. Charles O. Thompson, who was for fourteen years the executive head of the Institute, and who was eminently fitted by his tact and courtesy, his quick perceptions and his power of easily adapting words and work to new relations, and by his successful experience as an educator, to conduct the proposed experiment.

That the distinctive features of the Institute were regarded as experimental, even after three or four years' trial, appears from the catalogue of 1871–72. In mention of the causes of failure in previous efforts to combine manual labor with school work, one cause was shown to be that the attempted work had been allowed to degenerate into play. The aim and methods employed, as now understood, were then set forth, but it was added: "The whole scheme must be regarded as an experiment in American education, which, at the present stage, is sufficiently promising to warrant its further prosecution."

Those first years were years of organization and

rooting. The conditions of admission were the common English branches and algebra to quadratics. The lower limit of age was at first fourteen years, and the average age of the earlier classes at admission was about seventeen and a half years; since 1871 the limit has been sixteen years, and the average age at admission is now nearly nineteen years. The courses of study were originally six, and each covered three years. Practice began at the middle of the first year and was all done afternoons from two to six and Saturday morning from eight to twelve.

The first apprentice class entering for the extra half-year's work in shop and drawing was admitted Feb. 20, 1872. It consisted of fifteen members. It never exceeded nineteen till 1882, when the enlargement of the Shops permitted the admission of twenty-five. In 1885 the number was increased to thirty-two, in 1890 the limit was removed, and in that and the following years, till the four years' course was adopted, the numbers were forty-two, fifty-two, sixty-three, and sixty-eight. The advertising of a limit in respect to numbers was always a hindrance to growth. Many, who otherwise would have applied for admission, would not try the examination when success in it was not to make sure of entrance.

During all this period of experiment and of financial struggle, while the community around watched and waited, and sometimes criticised, the faculty held on unflinchingly to their plan and methods, and the trustees abated not a jot or tittle of their confidence

in the ultimate success of their general scheme. Not to mention some who are now living and others still who are among the unseen, it has seemed to me that to three or four of the original trustees the Institute is very largely indebted for its secure establishment and broad foundation. Mr. David Whitcomb brought Mr. Boynton's gift to Worcester. He was the first treasurer of the Institute. His sagacity and thorough acquaintance with practical affairs and his unswerving integrity were the basis of Mr. Boynton's confidence in him, when the latter entrusted to him almost his whole fortune without receipt or security. And of that confidence, I think, he spoke with more pride than of any other event of his life.

Dr. Sweetser and Mr. Ichabod Washburn outlined the plan of work of the Institute, aided by the suggestions of Gov. Emory Washburn, while Mr. Salisbury, the first president of the Board, a fast friend of all the others, stood ready to encourage and generously support any public enterprise in respect to which they were agreed. The Institute was fortunate in its other counsellors and the aid they afforded, in the acuteness and breadth of Mr. Hoar, in the genuine and generous interest of Messrs. L. J. Knowles and P. L. Moen, and in the practical wisdom and large mechanical experience of Mr. Ichabod Washburn and Mr. C. H. Morgan. They were not the men to put their hands to the plow and look back, to be discouraged by a temporary east wind, to hang upon the gaze of popular favor or disfavor, or to make a promise and then shirk its

fulfilment. Dea. Washburn's $10,000 for a shop grew to a more expensive building, with $5,000 for equipment, $50,000 for its endowment and $30,000 besides for the general purposes of the Institute. Mr. Whitcomb more than once drew his check on his own private account for the payment of the deficit of current expenses, joined Mr. Salisbury in bearing half of the cost of the additions made to the Shop in 1881, and in the same year gave $20,000 to the general endowment. His good sense and the unstinted time he gave to the Institute were worth more to it than his weight in gold. His rugged face hid a tender heart. He had sympathy with boys who were working their way, and was one of the two or three men—Mr. P. L. Moen was another—who said to me, "If you know of those needing aid and to whom a loan or a gift would be a relief, let me know." Mr. Salisbury's gifts grew with the need of the Institute. First the site, twice enlarged by additions, and $22,000 for the original building fund, then the graduates' aid fund, in order that stimulus might be given to all for the attainment of a high standard. He gave liberally for endowment, but with this purpose (I quote from his own lips): "I have wished and given my money that the school might not be a merely local institution; it will be better if it has a broader patronage." At his death* his aggregate gifts had amounted to nearly a quarter of a million of dollars. As president of the corporation he gave to the faculty a most cordial support and to struggling students, substantial sympathy. Some

* August, 24, 1884.

students once complained to him of discipline that was partial—some one uncaught had gone unpunished. "Yes, young gentlemen," was the laconic reply, "we always punish those we catch." That was the end of the appeal.

After nearly fourteen years of efficient service, Dr. Thompson resigned to accept the presidency of the newly established Rose Polytechnic at Terre Haute, Ind. (He was then eight months abroad, had successfully inaugurated the work of that institute and continued it about a year, when he died, lamented by a wide circle of friends, both in Worcester and in his new home). The Institute had begun to recover from the effects of the financial depression of 1873-77. Its students were increasing and there was good demand for its graduates. But income from its invested funds had been gradually diminishing through decreasing rates of interest, and most of the original State fund had been expended in equipment of the school and shops and in meeting the deficit of current expenses. Receipts from tuition up to this date had never been quite $6,000 annually.

The laboratories in Boynton Hall were straitened and unsuited for their purpose, there was no library except the few books in the office, nor was there room for one. It seemed impossible that the school should grow much farther without ampler quarters and it could not be continued without debt. There was published in the early summer of 1883 a statement of the work and the needs of the Institute, the suggestion of a plan for enlargement and the appeal to the public for the requisite funds. It was

proposed to extend Boynton Hall forty-five feet on the west and to build a chemical laboratory on West street (where now it is planned to erect a new engineering laboratory) and to increase the endowment. The project was successful only in securing a part of the desired endowment. This relieved for a little the most pressing necessity. It furnished income for current expenses. The wisdom of extending the time of the course of study was also discussed. But this scheme slumbered for lack of funds. A part of the basement was fitted up as an annex to the physical laboratory, and here Prof. Kimball, whose work at the Institute began in 1870, set up his dynamos, using power from the Shops. In 1886, the second State grant of $50,000 was made.* This reinforced the endowment, only the income being available for current expenses. Meanwhile there was a steady growth in numbers,—only one year, 1886–87, showing any abatement of the rising tide,—and Boynton Hall became crowded as a bee-hive.

The quarters for chemistry and physics grew to be entirely inadequate and there was no place for test work in mechanical engineering. At this critical juncture Stephen Salisbury, Esq., whose interest in the Institute dated from the very inception of the enterprise, on April 20, 1887, made a communication to the corporation, which began as follows:

"I am anxious to assist by placing at the disposal of the trustees the sum of one hundred thou-

* A first grant of $50,000 was made by the legislature of Massachusetts by a resolve approved May 10, 1869.

sand dollars, to be expended by them in the erection of a suitable building to contain laboratories for mechanical, physical and chemical science."

A more wise, timely, or fruitful gift than this was never made to any institution. It gave opportunity to broaden the scope and purpose of the training given, it cheered despairing instructors, it attracted students. For once the professors who were to occupy it had free range to plan the interior of a new structure; the architect must be content to assemble their arrangements. Yet Mr. S. C. Earle, the architect, was as happy in this as he could be, no more exhibiting impatience or asserting inability to adopt suggestions than he did when making the plans, much in his own way, for the earlier Boynton Hall, for the Art Museum at Norwich, or the beautiful Central Church of our own city. The corner-stone of the Salisbury Laboratories was laid with appropriate ceremonies June 2, 1888; it was completed barely in season for occupancy in the autumn of 1889.*

Mention should be made of the picturesque magnetic laboratory erected at the foot of the Institute Hill in 1887. This is an architectural gem, one of Mr. Earle's, although Prof. Kimball is responsible for the interior of it, and Mr. Salisbury included the expense of it in his donation. Mr. Salisbury, also, assisted by Prof. White, deftly

---

* This building is 145 x 100 feet in extreme dimensions, has four floors available for use beside sub-basement and roof-room, and is especially appropriated to work in mechanical engineering, physics, and chemistry.

The department of Mechanical Engineering occupies in the basement,

extended Mr. Vaux's arrangement of the older part of the grounds to the newly graded portions.

The equipment of the Salisbury Laboratories was slower than the erection of the building, and it is not yet entirely completed. But to this date Mr. Salisbury has paid for this equipment $24,361 additional to the original gift of $100,000, and also in 1891 caught quickly a suggestion of a member of the faculty and gave and graded the beautiful slope of the Institute grounds south of the old "Jo Bill" road.

In the summer of 1889, after Professors Alden, Kimball and Kinnicutt were well established in the new laboratories, there was a memorable overhauling in Boynton Hall. Mr. G. Henry Whitcomb proposed to defray its expense, but Mr. Salisbury offered to share the renovation. At the end of the sum-

---

which is wholly above ground, two laboratory rooms, each 44 x 40 feet, —one for steam engineering, to which the boiler-room is adjacent,— the other for general testing and for dynamos,—and another testing laboratory 40 x 15 feet; and on the first floor drawing and model rooms, each 40 x 40 feet; a lecture room, private study and reading room.

To the work in Physics are devoted in the basement an electro-technical laboratory, 63 x 24 feet, a constant temperature room and a store-room; on the first floor an electrical laboratory for advanced work, 63 x 24 feet, a spectrometer room, 30 x 26 feet, and a battery room; and the whole of the second floor, which is intended for class work in physics. Among the more important rooms on this floor are a lecture room, 40 x 40 feet, a general laboratory, 40 x 40 feet, a laboratory for elementary electrical work, 63 x 24 feet, an apparatus room, 40 x 15 feet, a photographic room, 26 x 16 feet, a photometric room, 23 x 12 feet, a calorimeter room, recitation room and study.

The department of Chemistry occupies, in the basement, rooms used for assaying, gas analysis, acids and other stores, and the whole of the upper, or third floor. This contains a general, an analytical, an organic, an industrial, a sanitary, and a gas laboratory, beside a reference library room, and special rooms for research.

mer, besides other needed repairs, there had been completed a library and reading-room, a private office, a civil engineers' drawing-room and recitation-room for that department, a mineralogical laboratory and cases for specimens, lavatories and lockers for two hundred and thirty students, and new steam-heating apparatus. The work was done at an expense of $12,840.

This sketch of the Institute would not be complete without record of the gift made by Stephen Salisbury, Esq., of Oct. 1, 1887, of the tract of land known as Institute Park, which was conveyed by deed to the City of Worcester but with the provision that, after twenty years from that date, the Institute might erect and maintain upon the highest point of the Park one or more buildings for educational purposes.

In the summer of 1892 the Washburn Shops had become too crowded for convenient use, and there was not room enough for new machinery needed for the growing classes. Recitation-rooms were also insufficient in number. Accordingly it was determined to erect the later addition to the Shops, a building 100 x 51 feet and four stories in height. The work was begun in June and completed in December. The basement furnishes a fine forge-room, the first floor an extension of the machine shop, the second floor a commodious wood-room, and the third a fine drawing-room, with adjacent model and blueprint rooms. And now, in five years from the time when it really burst its first shell, notwithstanding floor space had been increased one hundred

and fifty per cent. in that time, the Institute is forced, both through the growth of numbers and through the increasing demand for engineering laboratory experiment and investigation, to plan for another building, 116 x 52 feet, and a power plant besides, to be located west of the Washburn Shops, and a hydraulic testing plant at Chaffin's Station in Holden. So much may be said concerning the habitations and utensils of the Institute recently provided.

There have also been changes in the courses of study. That in architecture was dropped after the first class was graduated in 1871, lack of funds here and the better illustrations of the work in large cities making its continuance inexpedient. There was a course of practice in drawing till 1888, when the superior advantages offered at the Art Museum and Lowell School of Design in Boston could not be competed with. A course of physics was announced in 1875, but in 1888 it was dropped. Its work in a broader form reappeared in the graduate course in electrical engineering, which was established in 1889. In 1890 the general scientific course was offered, and in 1892 the undergraduate course in electrical engineering. The courses in chemistry and in civil and mechanical engineering have been contemporaneous with the life of the Institute. The students in the last named course have constituted by far the largest portion of most of the classes; in those of 1872 and 1876 the civils predominated. The terms of admission to the Institute remained the same from 1868 to 1884. They have since been advanced by more English and algebra, French and

both plane and solid geometry. That is, fully three years of high school work, at the least, are now requisite for preparation, where formerly one year following a high grade grammar course was sufficient. Says Col. Carroll D. Wright, in his comparison of the work of institutes of technology, just published in the Report of the Commissioner of Labor for 1892:—

"The Worcester Polytechnic Institute, though sometimes classed with schools of manual training, is virtually an institution of college rank. The requirements for admission to the lowest class are fully equivalent, except as to Latin and Greek, to the standard of entrance examination in the best New England colleges."

The changes within the courses of study are noteworthy. Since 1882 there have been added inventional geometry, advanced French, and more physics for all courses; steam engineering, engineering laboratory and hydraulics for civils and mechanics, special topics in chemistry have replaced the advanced mathematics formerly given in this department and there is a choice in the Senior year between shop work and electricity. The total number of recitation divisions has doubled. In 1882, the number of professors was seven, of instructors two, assistants one; in 1894, professors and assistant professors thirteen, instructors eight, assistants five, exclusive of all instruction in shop. In 1882, the number of students was one hundred and twenty-one, in 1894, two hundred and fifty-seven; total income in 1882–83, $24,000; in 1894, $53,000, exclusive of income and tuitions carried to shop account.

The total endowment fund in 1883 was $408,000; in 1894, $552,000, or including the recent State grant over $600,000, exclusive of cash balances.

Since July 1, 1883, the Institute has received $142,000 for endowment and $198,000 for buildings, repairs, equipment, library, and special gifts for current expenses.

The funds of the Institute have been wisely and conservatively invested. The market value of its investments, May 1 of this year, was equal to the cost of those investments and was $20,000 above the par value of the funds. During the past year of financial stress and depreciation, the aggregate dividends and interest on investments have been only $200 less than the year preceding. It has been clearly proved here, as elsewhere, that on the whole no funds are better cared for or longer endure than those entrusted to educational institutions.

In the earlier part of the decade just closing, it became apparent that a free school for an unlimited number could not be maintained. Either the total number of students must be limited or the free tuition must be limited. The gifts of the largest benefactor of the Institute — the elder Salisbury — contemplated a wider than local benefit from the funds. Hence, in 1889, it was determined to allot the entire income from the Boynton fund in thirty-five scholarships for Worcester county. These, with the State and district fund scholarships, made fifty-six in all. This step, opposed by some at the time, has enhanced the estimate of the Institute's

training. It was averred that the change would sound the death knell of the work: as a fact, the number of students increased steadily. What costs is prized: what is given is often, like food bestowed on tramps, thrown away. No more than before has any needy and really promising student, residing within the county or State, who could not wisely wait, failed to receive some assistance.

The most difficult problem recently presented in the practical administration of the Institute has been how to find time for the new work which the continual fresh discoveries in the arts and the new applications of science rendered necessary. Sixty hours of assigned work weekly were found to be more than the average student could be firmly and thoughtfully held to. We came up to that limit, and then decided, faculty and trustees, in November, 1892, that all courses of study should be four years in length. The scheme drawn comprised additional applied, especially laboratory, work in senior year, and set fifty-two hours as the average weekly task. Its operation the past year has proved eminently satisfactory. There is a limit to human endeavor. The bow, sprung too far, snaps. There is no compensation for the loss of that elasticity of spirit, which, rather than grace of face or form, is the charm of youth. The education that is wise, though it involves drudgery, makes no mere drudges or machines. Yet it must stretch the man or it is useless. If the bow is not sprung the arrow never flies to the mark.

The same thought applies to teachers as well as

to students. The instructor who does not outstrip himself sets no good pace for others, but if the work is too heavy it suffers in quality. The professor in his class or lecture room should be at his best, but if he must be confined there all the time he cannot always be at his best. The average hours of instruction given at the Institute per man are more than are generally given by college professors, and have often precluded the scholarly research and patient investigation in which it would have been a delight to engage.

While most of those who have wrought in the heat and burden of the day are vigorous for further service, I cannot forget that two or three valued instructors have fallen by the way. One, Mr. A. M. Chapin, died June 5, 1880; another, Prof. T. E. N. Eaton, in June, 1891, after nineteen years of excellent service, retired with shattered nerves and throbbing brow to the more genial climate of California. The third, Prof. E. P. Smith, after twenty years of most faithful instruction, died May 12, 1892, as suddenly as the stretched wire snaps in the testing-room. If he spared not others he never spared himself, and he lived and toiled long enough to see the department he opened firmly established, recognized as an essential and indispensable part of any course of study and acknowledged by graduates to be as practical as any feature of the Institute training.

Of all the instructors of the Institute it may be truly said that they have devoted themselves mind and soul to their work, and have made it their pride

and delight. What that work really is—to have daily and almost hourly contact with young, fresh, vigorous life, full of ambition, hope, and promise, to watch the change from boyhood to manhood, to see seed sown slowly germinate, take root, grow and mature, to discern impulsiveness give way to self-control, self-confidence to thoughtfulness, self-assertion to search for truth, to feel responsiveness, or questioning, or doubt, or sometimes distrust or opposition, to be drawn into sympathy with the difficulties, the perplexities, the aspirations and the endeavors of those before you so constantly, to witness the result of wrestling with those difficulties, the stimulus of a noble purpose and the fruitage of persistent industry, to realize that in this daily intercourse each life becomes a part of your life, and your life a part of that other life—no man knows that work who does not engage in it, and he that does know it cannot tell it to another.

Thus I have endeavored to show that the quarter-century just closed, while a period of almost continuous growth, may be fairly divided into two epochs —one, of organization and experiment; the other, not less difficult or important, of reorganization and adjustment. I confess my inability to do justice to the earlier epoch. I know it chiefly as a tradition, and I know its fruit.

I am sure, however, that in the later epoch there has been not only growth of numbers and increase of resources and equipment, but a broadening of the general policy of the Institute, an enlargement of its

scope of work as demanded by the times, more flexibility in its methods and a better adaptation of its training to individual needs. Not all, however, that is desirable has yet been attained. There is still room for improvement, and there must in the future be fresh adjustments to changing conditions. What in method, scope, and proportion is good to-day will, like the clothing of a growing boy, to-morrow be outgrown. But sure foundations have been laid. The utility of combined study, handicraft and laboratory work is no longer problematic. The wisdom of attempting to construct serviceable wares as a part of educational training in mechanical and electrical engineering is not gainsayed by those who know the method and its results. The reputation of the Institute is wide and honorable. It has the confidence of the citizens of Worcester, as is shown by the quadrupled attendance of students from the city within ten years.* Its graduates have done work—alike creditable to themselves and to their alma mater. The experiment has been pronounced a success. It not infrequently comes to me as the judgment both of employer and of scientists that in its plan and methods, and in many respects in the actual results attained, the Institute stands in the front rank of its kind. In those features of its work which are most distinctive and unique, it invites comparison with any similar institution in the whole world. Its usefulness is assured. Its future cannot fail of realizing a brilliant promise. The Institute of

* In 1883 there were registered as from the city of Worcester 29 students; in 1893, 112.

this year, measurably successful in what it has undertaken through the sagacity of its founders, and somewhat uniqueness of its plan, the succor given to it from time to time by the trustees and by the State, and especially through the untiring and self-sacrificing labors of those who have immediately administered its affairs, led its counsels, solved its problems, and with pains and skill and patience wrought upon both experiment and transformation, will, in the coming years, if generously supported, wisely governed and unitedly and unselfishly labored for, continue to be one of the chief ornaments of the city, become still broader and more beneficent in its influence and prove to all the youth of this region an unspeakable and enduring blessing.